

Title:

Manufacturing of 5.5 Meter Diameter Cryogenic Fuel Tank Domes for the NASA Ares I Rocket

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Abstract:

The Ares I rocket is the first launch vehicle scheduled for manufacture under the National Aeronautic and Space Administration's (NASA's) Constellation program. A series of full-scale Ares I development articles have been constructed on the Robotic Weld Tool at the NASA George C. Marshall Space Flight Center in Huntsville, Alabama. The Robotic Weld Tool is a 100 ton, 7-axis, robotic manufacturing system capable of machining and friction stir welding large-scale space hardware. This presentation will focus on the friction stir welding of 5.5m diameter cryogenic fuel tank components; specifically, the liquid hydrogen forward dome (LH2 MDA) and the common bulkhead manufacturing development articles (CBMDA).

The LH2 MDA was the first full-scale, flight-like Ares I hardware produced under the Constellation Program. It is a 5.5m diameter elliptical dome assembly consisting of eight gore panels, a y-ring stiffener and a manhole fitting. All components are made from aluminum-lithium alloy 2195. Conventional and self-reacting friction stir welding was used on this article. Manufacturing solutions will be discussed including the implementation of photogrammetry, an advanced metrology technique, as well as fixtureless welding. The LH2 MDA is the first known fully friction stir welded dome ever produced.

The completion of four Common Bulkhead Manufacturing Development Articles (CBMDA) will also be highlighted. Each CBMDA consists of a 5.5m diameter spun-formed dome friction stir welded to a y-ring stiffener. The domes and y-rings are made of aluminum 2014 and 2219 respectively. An overview of CBMDA manufacturing processes and the effect of tooling on weld defect formation will be discussed.